EFFECT OF RATION BALANCING ON PERFORMANCE OF LACTATING BUFFALOES UNDER FIELD CONDITIONS IN THE MALWA REGION OF MADHYA PRADESH

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ABSTRACT

The present study was carried out to observe the effect of ration balancing on performance of lactating buffaloes under field conditions. Sixteen healthy lactating graded Murrah buffaloes under 3rd or 4th lactation (8 to 10 weeks after parturition) identical in body weights and feeding conditions were selected from the village kewati tehsil Mhow. The representative samples of each feed ingredient were collected and analysed for proximate principles, fibre fractions, Ca and P. Carotene, DCP and TDN in feedstuffs were calculated. Feed intake of individual animal was measured for fifteen consecutive days. Then nutrient (DCP, TDN, Ca, P and Carotene) supply was calculated and compared with standard requirements to work out nutrient excess/deficit. Based on body weights and milk yield, these animals were divided in two equal groups (Group 1, un-balanced and Group 2, balanced ration) eight animals in each. Group 1 was fed as per the practice of farmer while ration of Group 2 was balanced for DCP, TDN, Ca, P and carotene based on standards for buffaloes. This feeding was continued for 90 days. Weekly DM intake and daily milk yield were recorded. Milk samples were collected fortnightly and fat content was estimated. The economic impact of ration balancing was also assessed. Results indicated that rations of lactating buffaloes were adequate in TDN, slightly higher in DCP (+12%) and Ca (+16%) but marginally deficient in P (-17%) and carotene (vitamin A, (-) 13%). DMI and milk yield (9.21±0.11 kg/h/d) were significantly ($P<0.05$) higher in Group 2 as compared to Group 2 (8.48±0.14 kg/h/d). The milk fat % was significantly ($P<0.05$) higher in Group 2 in comparison to Group 1 during 5th and 6th fortnight. After ration balancing, there was an average reduction in feeding cost (Rs/kg milk) from 21.68 to 20.65 and increase in farmer's daily net income by Rs 23 (Rs 155 to 178) per animal. It was concluded that balancing of ration in lactating buffaloes significantly improved DMI, milk yield and reduced the feed cost and increased farmer's net income.

Keywords: *Bubalus bubalis*, buffaloes, ration balancing, field condition, Malwa region

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INTRODUCTION

Low productivity in dairy animals can be primarily attributed to the imbalanced and inadequate feeding. Imbalanced feeding leads to excess feeding of some nutrients while others remain deficient. This not only reduces milk production and increases costs per kg milk, but also affects various physiological functions i.e., animal health, fertility, and productivity (Garg *et al*., 2014a). Thus, it is necessary that dairy farmers should feed their animals on scientific lines. Many studies indicated that feeding nutritionally balanced rations improved milk production, feed conversion efficiency, farmer's net income and reduced methane emission in lactating animals under field conditions (Garg *et al*., 2009; Kanan *et al*., 2011; Sherasia *et al.*, 2016).

In Malwa region of Madhya Pradesh, farmers are following traditional feeding practices. Dairy animals are mostly fed on straw-based ration with un-decorticated cotton seed cake and/or wheat bran/commercial concentrate mixture without any mineral-vitamin supplement. Few farmers offer seasonal green fodders like maize, MP chari, jowar, naturally available local green grasses, during kharib and berseem and lucerne during rabi (Tewari *et al*., 2012). Due to non- availability of balanced ration to dairy animals, productive performance is not up to the level of the satisfaction. Hence in crop residue-based feeding system, ration balancing could be an important strategy to make the best use of available resources with nutritional and environmental benefits. Considering this fact in mind present study was planned to demonstrate the effect of ration balancing on performance of lactating buffaloes under field conditions.

MATERIALS AND METHODS

Sixteen lactating graded Murrah buffaloes under 3rd or 4th lactation (8 to 10 weeks after parturition) identical in body weights and feeding conditions were selected from the village kewati tehsil Mhow for the study. Feed offered and feed residue left by each animal were measured for fifteen consecutive days with the help of digital balance for obtaining the feed intake. Their after-feed intake was recorded at weekly intervals for individual animal of both the groups during the experimental period. Body weights were calculated from body measurements by using the Shaeffer's formula (Sastry *et al*., 1982).

Feed samples collected from the selected farmer and analyzed for proximate principles *viz*. dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen-free extract (NFE) and total ash by (AOAC, 1995) methods. Fibre fractions (NDF, ADF) were estimated as per Vansoest *et al.* (1991). Nutritive value (DCP and TDN) of available feedstuffs were calculated with the help of digestibility coefficients reported in the literature (Morrison, 1961; Sen *et al*., 1978; Pal *et al*., 1985; Mehta *et al*., 2004). Calcium in feed samples was determined by modified method of Talpatra *et al.* (1940) and Phosphorus in feed samples was estimated by Metavandate method (AOAC, 1995). The carotene content of feeds was calculated by using the values reported in the literature (Morrison, 1961; Sen *et al*., 1978). The average availability of carotene was converted to vitamin A (IU) by using formula (Kearl, 1982) i.e., 1 mg β-carotene = 400 IU vitamin A activity. Data of feed intake and nutritive value of feedstuffs (DCP, TDN, Ca, P and Carotene) were used to determine supply of nutrients to animals and this supply was compared with standard requirements

(Paul and Lal, 2010) to work out nutrient excess/ deficit. Based on body weights and milk yield the above animals were divided in two equal groups (Group 1, un-balanced and Group 2, balanced ration) eight animals in each. Group 1 was fed as per the practice of farmer while the ration of Group 2 was balanced for DCP, TDN, Ca, P and vitamin A based on Paul and Lal (2010) standards for buffaloes. This feeding was continued for 90 days. DM intake (weekly) and milk yield (daily) were recorded for individual animal. Milk samples were collected and analyzed for fat content (IS: 1224, 1977) at fortnightly intervals. The economic impact of ration balancing was assessed by calculating feeding cost (Rs/kg milk) and farmer's net income per animal/day.

RESULTS AND DISCUSSION

The average chemical composition and nutritive value (% DM basis) of feedstuffs available for feeding buffaloes are presented in the Table 1. The available feeds were mixture of straw {wheat (*Triticumaestivum*) + gram (*Cicerarietinum*)}, un-decorticated cotton seed cake (*Gossipium* spp.), grain mixture {(bajra (*Pearl millet*) + wheat (*Triticumaestivum*) + maize (*Zea maize*) + soybean (*Glycine max*)} and maize fodder (*Zea maize).* The chemical composition of available feedstuffs is more or less in the same range as reported by other workers, except the EE content (9.60±0.50%) in cotton seed cake was higher in this study as compared to other reported values i.e., 1.70 to 9.40% (Morrison, 1961; Sen *et al*., 1978; Kearl,1982; Ranjhan, 1991; NRC 2001; Mandal, 2002; Mudgal *et al*., 2003; Tewari *et al*., 2014; Thakur *et al*., 2016). On comparison of proximate composition of cotton seed cake with BIS specifications (BIS, 2003) it falls under the category 'un-decorticated Grade 2 cake'. NDF of straws was more or less within range while it was lower in maize fodder (60.94±0.71%) than reported values (62.25 to 62.32%) by Ranjhan (1991); ICAR (2013). NDF and ADF in cotton seed cake were higher (ICAR, 2013) and within range for different grains than reported values (NRC, 2001). The mixture of straw (wheat + gram) has highest Ca (0.82±0.05%) and grain mixture has lowest Ca (0.21±0.03%) with an average 0.54±0.14%. Phosphorous was highest in grain mixture (0.57±0.01%) and lowest in wheat + gram straw (0.10±0.02%) with an average 0.37±0.11% and the carotene contents was highest in maize fodder (58.74 ppm, having 32% DM) and lowest in grain mixture (0.10 ppm). The average value of Ca and P of available feed stuffs were more or less within the range as reported by others (Morrison, 1961; Sen *et al*., 1978; Kearl, 1982; NRC, 2001; Lal *et al*., 2000; Mudgal, 2003; Garg *et al*., 2008a, b; Shinde and Sankhyan, 2008; ICAR, 2013; Patil *et el*., 2014; Tewari *et al*., 2014; Thakur *et al*., 2016). Calcium content in grains and cotton seed cake was lower and it was higher in straws and maize fodder than their critical values reported by Datt and Chhabra (2005). Phosphorous content was inadequate in both straws otherwise it was adequate in rest feedstuffs when compared with their respective critical values (Datt and Chhabra, 2005). The carotene content in feedstuffs ranged between 0.20 to 58.74 ppm. Nutritive value of different feedstuffs in term of DCP and TDN were within range reported by other workers (Morrison, 1961; Sen *et al*., 1978; Kearl, 1982; NRC, 2001; Lal *et al*., 2000; Mudgal, 2003; Garg *et al*., 2008a, b; Shinde and Sankhyan, 2008; ICAR, 2013; Patil *et al*., 2014; Tewari *et al*., 2014; Thakur *et al*., 2016), except, DCP was lower in maize fodder (3.03±0.01). This lower DCP might be due to that

available maize fodder was cut at late stage (32 % DM).

Daily requirements and availability of nutrients in lactating buffaloes are presented in Table 2. Data indicates excess of 12% DCP, Similar excess of DCP was also recorded by earlier workers (Garg *et al*., 2009; Garg *et al*., 2013a; Garg *et al*., 2013b; Garg *et al*., 2014b; Sherasia *et al*., 2016) in lactating buffaloes of western and southern region (Gujarat) of the country. The average daily TDN intake in lactating buffaloes was 7.73±0.02 kg, which was slightly lower than recommended by Paul and Lal (2010). Dietary deficiency of TDN was also observed by others (Lal *et al*., 1995; Garg *et al*., 2012; Sherasia *et al*., 2014). Whereas Garg *et al*. (2013a, 2013b); Garg *et al.* (2014b); Sherasia *et al.* (2016) found excess TDN in the ration of lactating buffaloes. Adequate TDN levels were observed by Kannan *et al*. (2010, 2011) in the ration of lactating buffaloes of Raebareli district in Uttar Pradesh and Chitoor district of Andhra Pradesh. Calcium was excess by 16% and phosphorous was deficient by 17% in the ration of lactating buffaloes in the present study. Similar excess for Ca was also observed by Garg *et al*. (2013b). While others (Garg *et al*., 2009; Kannan *et al*., 2010, 2011; Garg *et al*., 2012; Garg *et al*., 2013a; Garg *et al*., 2014a, 2014b; Sherasia *et al*., 2014; Sherasia *et al*., 2016) were reported shortage of both Ca and P in the ration of lactating buffaloes. There was 13% shortage of carotene. Similar findings were also observed by Patil *et al.* (2016) and Thakur *et al.* (2016) in the ration of buffaloes of Malwa region of M.P. Effect of ration balancing on DMI is presented in Table 3. DMI was significantly (P<0.05) higher in Group 2 as compared to Group 1, this increase in DMI was from 3rd week when data were compared between weekly intervals. DMI was adequate when compared with values given by Lal and Paul (2010). Lal *et al.* (1995); Mudgal *et al.* (2003) observed short supply of DM in the ration of lactating buffaloes. Data of ration balancing on milk yield is shown in Table 4. The milk yield was significantly (P<0.05) increased in Group 2 (9.21±0.11 kg/h/d) when compared with Group 1 (8.48±0.14 kg/h/d). The average increase in milk production was 0.73 kg/h/d.

This increase in milk yield was after 8th week. Similar increase in milk yield after ration balancing was also recorded by earlier workers (Garg *et al*., 2009; Kannan *et al*., 2010, 2011; Garg *et al*., 2012; Garg *et al*., 2013ab; Garg *et al*., 2014a; Sherasia *et al*., 2014; Sherasia *et al*., 2016).

Effect of ration balancing on milk fat is presented in Table 5. The milk fat was significantly (P<0.05) higher in Group 2 during 5th and 6th fortnight in comparison to Group 1. However, when overall means were compared, difference in milk fat % between groups was non-significant (P>0.05) statistically. After ration balancing increase in milk fat % were also recorded by earlier workers (Garg *et al*., 2009; Kannan *et al*., 2010; Garg *et al*., 2012; Garg *et al*., 2013a, 2013b; Garg *et al*., 2014a; Sherasia *et al*., 2014; Sherasia *et al*., 2016). Whereas Kannan *et al*. (2011) was found no effect on milk fat in buffaloes after balancing of ration.

The economics of milk production is presented in Table 6. The ration of buffaloes of Group 2 was balanced with respect to DCP, TDN, P and vitamin-A as per the recommended requirements by Lal and Paul (2010) as shown in Table 6. The DCP was balanced by reducing the quantity of CSC (600 g/h/d). TDN deficiency was balanced by supplementation of mustard oil (110 g/h/d), Phosphorus deficiency was balanced by phosphorus supplement i.e., sodium dihydrogen orthophosphate added 51 g/h/d, and vitamin A deficiency was balanced by supplementation of

Table 1. Average chemical composition and nutritive value of available feedstuffs (%DM basis).

Feed stuffs	CP	EE	CF	NDF	ADF	TA	Ca	P	Carotene[c] (ppm)	DCP[a]	TDN[b]
Wheat straw + Gram straw	4.19±0.34	1.19±0.01	37.63±1.29	63.57±1.30	43.10±1.22	10.60±0.84	0.82±0.05	0.10±0.02	0.6	1.13±0.01	42.95±0.02
Grain mixture*	13.50±0.78	5.02±0.12	4.53±0.29	13.56±2.13	5.39±0.40	2.71±0.10	0.21±0.03	0.57±0.01	0.10	10.30±0.02	82.04±0.08
Cotton seed cake (Un-decorticated)	21.42±1.55	9.60±0.50	24.82±1.36	49.16±0.46	39.29±2.68	5.21±0.19	0.38±0.08	0.51±0.03	0.20	18.20±0.06	78.03±0.07
Maize fodder	4.97±0.45	1.41±0.10	20.88±1.10	60.94±0.71	39.98±1.76	10.54±0.11	0.73±0.04	0.28±0.01	58.74	3.03±0.01	67.16±0.08

a and b-Calculated from the reported digestibility coefficients; c - According to Morrison (1961).

*Grain mixture - Maize 25%, Wheat 30%, Bajra 32% and Soybean 13%.

Table 2. Average daily requirements and availability of nutrients in lactating buffaloes (1 mg β carotene = 400 IU vitamin A).

Particulars	Body weight (Kg)	Milk yield (kg)	Milk fat (%)	DM (Kg)	DCP (g)	TDN (Kg)	Ca (g)	P (g)	Vitamin A (IU)
Requirement (Paul and Lal, 2010)	525	9.00	6.50	13.06	871.00	7.74	69.20	44.90	41792
Availability (Per head/ day)	515.37±8.11	8.64 ±0.02	6.42±0.10	12.94±0.03	976.55±4.61	7.73±0.02	80.15±0.21	37.21±0.10	36220
Excess (+) /Deficient(-)	-	-	-	(-) 0.12	(+) 105.55	(-) 0.01	(+) 10.95	(-) 7.69	(-) 5572
Deficiency(-) / Excess(+) (%)	-	-	-	(-) 0.92	(+) 12.12	(-) 0.13.	(+) 15.82	(-) 17.13	(-) 13.33

Table 3. Effect of ration balancing on dry matter intake (kg/day) in lactating buffaloes.

Weeks	Group 1 (Unbalanced ration)	Group 2 (Balanced ration)
0	12.93^{abc}±0.04	12.95^{abc}±0.04
1	12.88^{abc}±0.06	12.98^{abc}±**0.06**
2	12.87^{abc}±0.07	12.98^{abc}±0.04
3	12.83^{abcA}±0.04	13.01^{abcB}±0.03
4	12.78^{abA}±0.12	12.99^{abB}±0.04
5	12.90^{abcA}±0.03	13.02^{abcB}±0.04
6	12.76^{abA}±0.09	13.02^{abB}±0.05
7	12.83^{abcA}±0.06	13.04^{abcB}±0.05
8	12.58^{aA}±0.012	13.07^{bcB}±0.04
9	12.87^{bcA}±0.03	13.08^{bcB}±0.04
10	12.86^{bcA}±0.07	13.13^{bcB}±0.06
11	12.83^{bcA}±0.05	13.12^{bcB}±0.06
12	12.92^{cA}±0.04	13.17^{cB}±0.05
Overall mean ± SE	12.83±0.03	13.04±0.01*

$^{abc\ \&\ AB}$Means with different superscripts within a column and row differ significantly (P<0.05), respectively.
*P<0.05.

Table 4. Effect of ration balancing on milk yield (kg/day) in lactating buffaloes.

Weeks	Group 1 (Unbalanced ration)	Group 2 (Balanced ration)
0	8.66±0.57	8.96±0.49
1	8.44±0.56	8.88±0.54
2	8.42±0.51	8.99±0.53
3	8.55±0.54	9.02±0.52
4	8.44±0.59	9.05±0.53
5	8.29±0.57	9.06±0.52
6	8.27±0.64	9.14±0.34
7	8.97±0.46	9.15±0.40
8	8.55±0.51	9.20±0.26
9	8.49^{a}±0.44	9.21^{b}±0.21
10	8.35^{a}±0.45	9.52^{b}±0.13
11	8.37^{a}±0.35	9.61^{b}±0.08
12	8.51^{a}±0.42	9.92^{b}±0.19
Overall mean ±SE	8.48±0.14	9.21±0.11*

^{ab} Means with different superscripts within a row differ significantly (P<0.05); *P<0.05.

Table 5. Effect of ration balancing on milk fat (%) in lactating buffaloes.

Fortnight	Group I (Unbalanced ration)	Group II (Balanced ration)
0	6.58±0.31	6.39±0.24
1	6.54±0.32	6.43±0.24
2	6.42±0.34	6.56±0.30
3	6.54±0.32	6.60±0.19
4	6.43±0.33	6.89±0.24
5	6.41^{a}±0.33	7.05^{b}±0.20
6	6.33^{a}±0.32	7.24^{b}±0.20
Overall mean ±SE	6.46±0.03	6.74±0.12 NS

[ab] Means with different superscripts within a row differ significantly (P<0.05); NS = Non-significant.

Table 6. Economics of milk production in lactating buffaloes.

Group I (Unbalanced ration)				Group II (Balanced ration)			
Feed ingredients	Feed intake (kg/h/d)	Rate (Rs/kg)	Cost (Rs)	Feed ingredients	Feed intake (kg/h/d)	Rate (Rs/kg)	Cost (Rs)
Wheat straw + Gram straw	7.01	5.50	38.56	Wheat straw + Gram straw	7.68	5.50	42.24
Maize fodder	4.51	4.00	18.04	Maize fodder	4.51	4.00	18.04
Cotton seed cake	4.52	24.29	109.79	Cotton seed cake	3.87	24.29	94.00
Grain mixture	1.00	17.50	17.50	Grain mixture	1.00	17.50	17.50
P supplement**	-			P supplement**	51.00 (g)	231.00	11.78
Vegetable oil* (Mustard oil)	-			Vegetable oil* (Mustard oil)	110.00 (g)	60.00	6.60
Vitamin A (5 lacs IU/g)	-			Vitamin A (5 lacs IU/g)	12.00 (mg)	2700.00	0.03
Total	17.04		183.89	Total	17.22		190.19
Average milk production (kg/h/d)	8.48			Average milk production (kg/h/d)	9.21		
Feeding cost (Rs/kg milk)	21.68			Feeding cost (Rs/kg milk)	20.65		
Selling rate (Rs/kg milk)	40.00			Selling rate (Rs/kg milk)	40.00		
Cost of milk produced (Rs/h/d)	339.00			Cost of milk produced (Rs/h/d)	368.00		
Farmer's net income (Rs/h/d)	155.00			Farmer's net income (Rs/h/d)	178.00		

*Vegetable oil TDN value 177% (NRC, 1996); **Sodium di-hydrogen ortho phosphate, di-hydrate ($NaH_2Po_4.2H_2o$).

vitamin A (5 lacs IU/g) 12 mg/h/d. After ration balancing, there was an average reduction in feeding cost (Rs/kg milk) from 21.68 to 20.65 and increase in farmer's daily net income by Rs 23 (Rs 155 to 178) per head/d, similar results were also noted by Garg *et al*. (2009); Garg *et al*. (2014b); Sherasia *et al.* (2016) in lactating buffaloes.

CONCLUSION

It may be concluded thatration of lactating buffaloes was adequate in TDN, slightly higher in DCP and calcium but marginally deficient in phosphorus and carotene (vitamin A). Ration balancing in lactating buffaloes improved milk yield, milk fat %, decreased feeding cost and increased farmer's net income.

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